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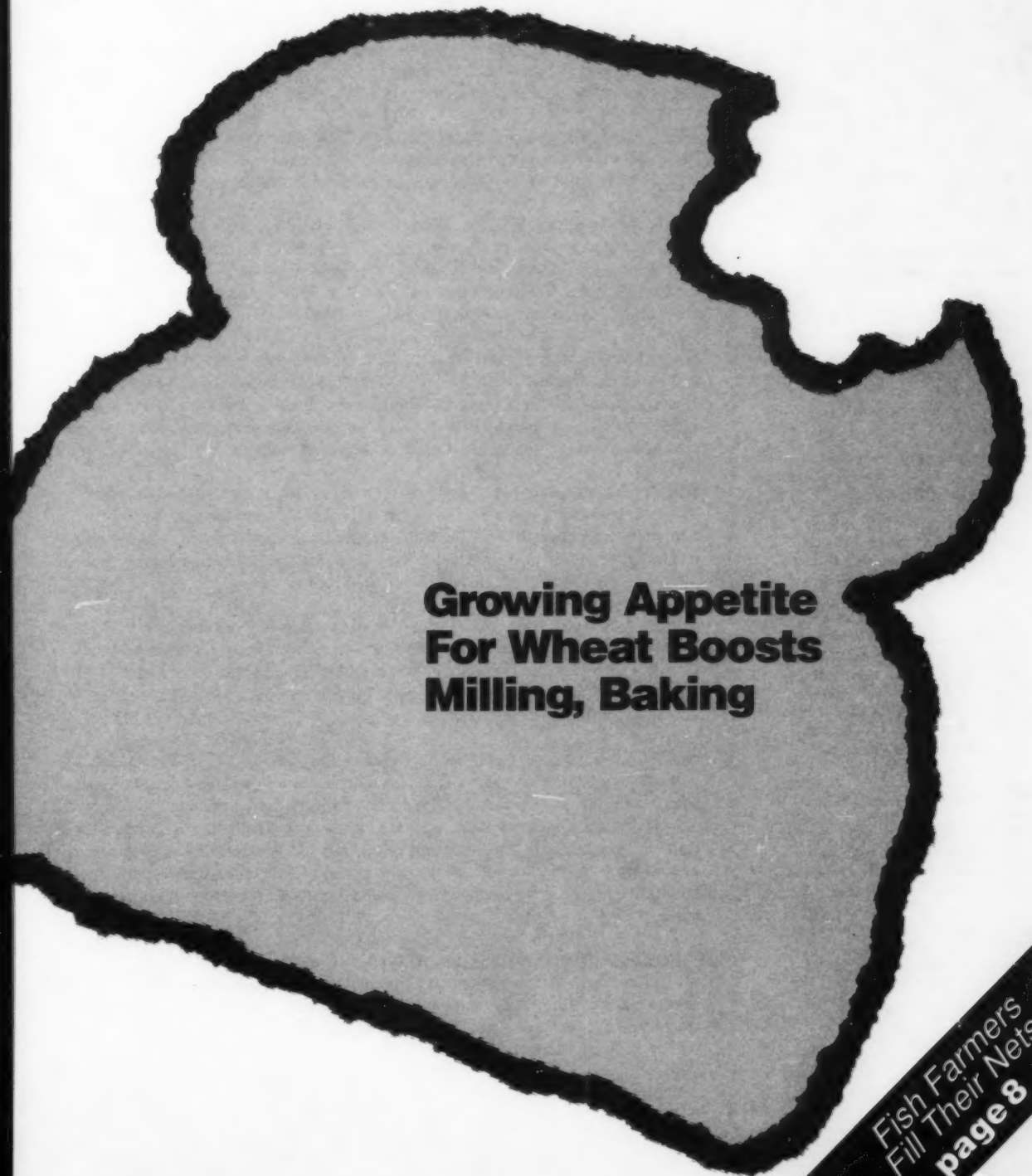

Growing Appetite For Wheat Boosts Milling, Baking

Fish Farmers Fill Their Nets
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PERSPECTIVES

ANOTHER DRY YEAR? It's too early to tell, says USDA chief meteorologist Norton Strommen, but a number of signs in recent weeks point to better weather for agriculture in most parts of the country in 1989.

"We've had an encouraging start this year," Strommen said in late February, "although the problems certainly are not over. The amount of precipitation we receive in March and April will be very important to this year's crops."

The winter wheat region of the Great Plains has been generally very dry this winter, but Strommen says that spring rains could save much of the crop. As of mid-February, rainfall for the winter had been near normal or above normal in most of the Corn Belt, the Northern Plains, and the Delta. "The big picture for moisture, nationwide, is favorable," Strommen says.

South Texas is another problem area, with an unusually dry winter. Parts of the East and Southeast also have been behind on rainfall. Water supplies (in snowpack and reservoirs) were low in much of California, where farmers have been told their irrigation water allotments will be cut this year. But other parts of the West received normal or above-normal amounts of snow and rain through the first half of the winter.

Soils that dried out last year still need a lot of recharging of moisture, although "conditions have improved a lot since last fall," in Strommen's words. Last September many parts of the Corn Belt needed as much as 12 inches of precipitation to reach normal soil moisture levels. But five months later, the moisture deficit in all but a few areas had been reduced to less than 4 inches.

The 1988 drought was a serious one, no doubt about that. Nationwide, only 5 years in the last 100 have been drier. The 1988 temperatures, however, were not quite so extreme. One year in 6 is usually hotter than 1988 turned out to be, according to the meteorologist. The drought cut last year's U.S. corn production by 37%, soybean output by 23%, and wheat production by 13%.

A brief period of record cold weather in early February probably killed some of the winter wheat crop, which was stressed from dry conditions and also lacked the usual amount of protective snow cover. "We won't know how much damage occurred until the wheat starts to grow in the spring," Strommen says. That cold spell harmed some fruits and vegetables in California and Texas, as well. Temperatures of 30 degrees below zero in the Northern Plains were the lowest in 5 years in several areas. But the blast of frigid air did not reach to Georgia and Florida, and damage to fruit crops there was apparently only slight.

What about the upcoming summer? Do the weathermen know if it will be dry or wet, hot or cool? The 90-day forecast through mid-April called for adequate moisture in most parts of the country, and such forecasts have been about 60% accurate in recent years. "But there is no reliable way to predict in the spring whether a drought will occur in the summer," Strommen says.

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FEATURES

Growing Appetite for Wheat Boosts Milling, Baking *by Doug Martinez* 4

The U.S. milling and baking industries are growing steadily, in response to an increase in consumption of food products made from wheat. Demand is rising partly because consumers are showing more concern for healthful eating and convenient products. And as output grows, the milling industry is becoming more consolidated.

Catfish Lead the Way as Aquaculture Booms *by Judith Foulke* 8

Aquaculture—also known as fish farming—has expanded rapidly during the 1980's. U.S. production in 1987 was valued at $650 million, with catfish accounting for over 40 percent of the total. Grain producers benefit by providing 650,000 tons of their crops annually for use in fish feed. Aquaculture provides alternative opportunities for a number of farmers who have been able to shift from traditional crops.

Drought's Economic After-Effects Differ by Regions *by Doug Martinez* 12

The economic after-effects of the 1988 drought varied from region to region and community to community. Several factors came into play. These included the types and mix of crops, availability of government programs, and agriculture's contribution to the overall economy of each area. Five specific regions hard hit by the drought are spotlighted and compared.

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Growing Appetite For Wheat Boosts Milling, Baking

American wheat millers are grinding it out to growing demand—billions of dollars worth of flour, much of it used to produce tens of billions worth of breads, cookies, crackers, and other bakery products.

Although wheat farmers indirectly share in the returns, a much bigger share goes to the milling and baking industries for processing the wheat into flour and food. These two industries operate in a highly competitive, but generally favorable, market.

"U.S. food consumption of wheat has grown steadily since 1970," reports economist Joy Harwood of USDA's Economic Research Service, "with per capita consumption rising by 17 pounds, or an average of 1 pound per year."

Setting the pace for this growth is the increasing American concern for healthful eating and convenience.

"Consumers are boosting their consumption of high-fiber, wheat-based products," says Harwood. "At the same time, they are buying more highly processed convenience foods, which generally contain large amounts of flour."

In 1987, American consumers spent more than $50 billion on retail bakery products, flour, pasta, and other grain mill products. This was up from $35 billion spent in 1980. Wheat is a primary ingredient in most of these products.

The strong demand has meant growth for many firms in both the baking and milling industries—growth in size, that is, but not in numbers.

"Today fewer plants and fewer companies are producing more product," says Harwood. "The number of plants in each industry has been slashed as smaller companies close their doors or sell out to larger interests. But total milling and baking output is higher, suggesting large increases in production per plant."

The obvious intent of consolidation, she says, is to increase production and distribution efficiency, expand output, and increase profitability.

In 1987, American consumers spent more than $50 billion on retail bakery products, flour, pasta, and other grain mill products.

Although the acquisition activity continues, she notes, it is not blurring the distinction between the milling and baking industries.

"The milling industry is more national in scope, while the baking industry is regional because baked products tend to be perishable," says Harwood. "And because of overcapacity and the need for frequent deliveries, baking companies have expanded their holdings primarily through the acquisition of other baking companies, while milling companies are frequently expanding individual plant capacities."

What the industries share, however, is an optimistic outlook based on a remarkable reversal in flour's fortunes.

"Per capita flour consumption was at 128 pounds in 1987—the highest mark since the early 1950's, and 4 pounds over the 1986 level," says Harwood. "This phenomenon provides a sharp contrast to the declining flour consumption levels recorded in the 1960's and early 1970's. It is also one of the first reversals in flour consumption in the developed world."

Health concerns, she says, have contributed significantly to increases in per capita consumption.

"Nearly two-thirds of the respondents to a USDA survey, for example, reported that they had made diet changes in 1985 and 1986 for health reasons," Harwood says. "Moreover, consumers increasingly recognize fiber, bran, and whole grains as cancer inhibitors."

Greater grain consumption particularly benefits those involved in the production of wheat products, she says, because wheat accounts for over 80 percent of total U.S. grain intake.

Other factors, too, have favored wheat consumption.

"Many manufacturers introduced wheat-based products to meet the demand for greater food variety in the late 1970's and early 1980's," Harwood says. "In part because of these efforts, food products that were once considered only in the specialty category—such as bagels, English muffins, and pita bread—are growing in popularity."

At the same time, she says, supermarkets are paying more attention to their in-store bakery sales, and retail bakeries are emphasizing specialty goods and cookies. "The boom in away-from-home eating has especially sparked the increase in per capita wheat consumption. Consumers are increasingly eating fast foods (which are often delivered in buns), pizzas, frozen meals in flour-based sauces, tortillas and other specialty items."

Further evidence of changing consumer tastes is found in figures from the U.S. Bureau of Labor Statistics. According to the bureau's surveys, weekly per capita spending on baked goods increased by about 20 percent between 1980 and 1984, says Harwood.

During this period, consumer spending rose most rapidly for cookies (43 percent), variety breads (36 percent), cakes and cupcakes (25 percent), crackers (25 percent), and fresh biscuits, rolls, and muffins (23 percent).

"In contrast, increases in spending on white bread—one of the staples of the wholesale trade—has lagged far behind," says Harwood.

For the flour milling industry, all this has meant increased demand for soft-type flour used in pastries and other sweet goods, and for nonwhite, whole wheat, high-gluten, and other bread flours.

A Look at the Milling Industry

In 1987, flour for domestic destinations and foreign ports was produced in the nation's 211 wheat flour and 18 durum wheat mills. Those states with the largest number of active mills include Pennsylvania (21), Min-

nesota (19), Kansas (18), New York (14), and Ohio (13).

"Pockets of milling activity are particularly noticeable in the areas surrounding Minneapolis, Buffalo, Kansas City, MO, and Lancaster, PA," says Harwood.

But plant numbers have declined in several Southern, Midwestern, and Northeastern states such as North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and New York.

Also changing is the share of output produced by the largest millers.

"Regardless of whether hard, soft, or whole wheat mills are examined," says Harwood, "capacities are expanding only for those mills with 10,000 or more hundredweight of daily capacity. These large mills accounted for about 55 percent of daily wheat flour capacity in 1987, a substantial increase from their 36-percent share in 1973."

Mills in the smallest size category (less than 1,000 hundredweight daily), she notes, are slipping most rapidly in their contribution to total U.S. capacity.

Larger plants are helped by economies of scale.

"Within limits, plant capacity can be expanded at a less than proportionate increase in energy and equipment costs," says Harwood. "Per-unit transportation costs can fall if a larger mill can negotiate lower rail rates than its smaller counterpart. Per-unit labor costs can drop sharply as output increases because the crew required to operate a larger processing unit is little or no larger than that for smaller plants."

Concentration and Conglomerates

"The flour milling industry has been linked more closely to wheat supplies and food processing by acquisitions among large conglomerates," she says. "ConAgra, for instance, is engaged not only in flour milling, but in feed manufacturing, poultry production, grain merchandising, commodity futures brokerage, and the production of a variety of prepared foods. General Mills, Pillsbury, and ADM have a similar pattern of holdings."

Cargill is one of the largest conglomerates involved in flour milling—and many other related businesses. In 1987, Cargill operated in 55 different countries and employed about 47,000 people. Sales exceeded $30 billion. Cargill's flour milling facilities are only a small part of the company's worldwide agricultural interests, which include grain elevators, corn wet milling facilities, juice production plants, malt plants, and tapioca production facilities. The company also has integrated egg, broiler, turkey, and beef-processing operations—along with a host of nonagricultural interests.

"By expanding their plant holdings, diversifying their interests, and integrating vertically, companies often improve their profitability through cost reduction," says Harwood. "These large, integrated firms can mill wheat to precise specifications for use in their food processing operations.

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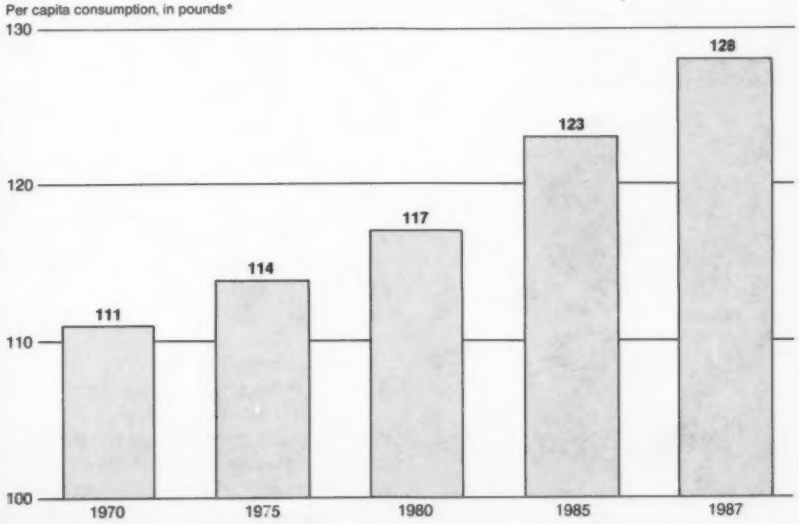
U.S. Food Consumption of Wheat Flour Is Growing Steadily



*Figures from USDA's Economic Research Service.

They can spread production, marketing, and financial risks over a large volume of activity, and lower the per-unit costs of accounting, financial, and legal talent."

But integration and diversification do not necessarily assure lower costs. In fact, the operations of several agribusiness firms have been sold off because of high risk and low profits.

Flour, Like Wheat, Varies in Types, Uses

Wheat flour is the primary grain product consumed in the United States. That's easily seen in the wide variety of grocery items that ultimately depend on the wheat grower and the wheat miller: packaged flour, bakery mixes, breads, cakes, cookies, and pastas.

Flour is also used in the production of breakfast cereals, soups, gravies, and other prepared foods.

However, the flours used in producing various bakery items are milled from different wheat classes.

Hard wheats are used mainly in the production of breads and rolls, and to a lesser extent in the production of sweet goods and all-purpose flour. Soft wheats go into the production of sweet goods, cakes, cookies, crackers, and prepared mixes. And some wheats are used mostly to prepare foods that don't appear in the bakery department. Durum wheat, for instance, is used almost solely in the production of pastas.

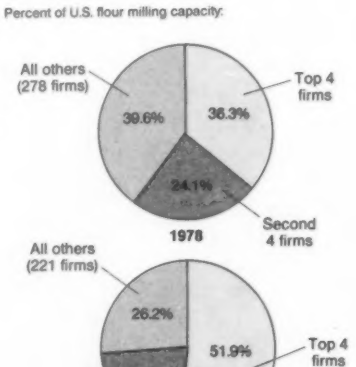
These wheats are grown in different areas depending on rainfall, temperature, and soil requirements. Hard wheats are produced largely in the Great Plains states of Kansas, Oklahoma, Texas, Nebraska, and the Dakotas. Soft wheats are grown in wide-ranging areas east of the Mississippi River, while durum wheat is primarily produced in North Dakota.

Concentration in the flour milling industry has substantially increased in the past 15 years as the largest milling firms have expanded their holdings. In 1987, the top twelve companies controlled almost 84 percent of total hard, soft, whole wheat, and durum capacity, up from the 68 percent of industry capacity held by the top twelve firms in 1973, according to Harwood.

The top four firms—ConAgra, ADM, Cargill, and Pillsbury—appear to be increasing their market share at the fastest pace, she says. "These top four firms controlled nearly 52 percent of all industry capacity in 1987, up from 34 percent in 1973."

Sizable acquisitions by these companies appear to be continuing in the late 1980's. ConAgra (the nation's largest flour miller) acquired International Multifoods in mid-1988. It now holds about 21.4 percent of U.S. capacity.

Concentration in the Wheat Milling Industry Has Increased to the Point That Four Firms Operated More Than Half of the Active Milling Capacity in 1987



Baking Industry More Regional

Reflecting its regional nature, the baking industry is far larger (in terms of plants) than the milling industry. About 2,700 wholesale baking plants were operating in the United States in 1982—more than 10 times the number of wheat milling plants.

"These plants typically specialize in the production of bread and cake items (2,305 plants) or cookie and cracker products (358 plants)," says Harwood. "Within these major categories, most plants produce only a few different items, such as bread and rolls or sweet goods."

She adds that perishability of product is the main reason there are more bread and cake plants.

"Because bread-type products have a shorter shelf-life than cookies and crackers, the bread and cake industry is smaller and more local," says Harwood. "Many of these bakeries are single-plant, family-owned operations with fewer than 20 employees."

But larger, multiple-unit bread and cake operations are more able to bear the additional costs and risks to develop regional (and, in a few cases, national) markets.

For large cookie and cracker manufacturers, on the other hand, the economies linked to long production runs are more important than the advantages of plant dispersion and reduced transportation costs.

"As a result, the large cookie and cracker companies have fewer plants and a more national focus than the large bread and cake companies," says Harwood. "Nabisco, for example, receives at least 15 percent of its annual sales from each U.S. geographic region."

New Competition

Although some wholesalers are very large and part of diversified firms, the bakery industry is not nearly as concentrated nationally as the milling industry. In fact, new competition is shaking up the industry, with traditional wholesale bakers (who sell their packaged products mainly through grocery

stores and supermarkets) being challenged by in-store bakeries and specialty retail outlets selling fresh-baked goods.

Between 1982 and 1987, the number of in-store units jumped from 13,800 to 18,850, an increase of 37 percent. In 1987, purchases from in-store bakeries totaled $4.8 billion, up from $4.4 billion in 1986.

Retail bakery sales (from outlets such as TJ Cinnamon's and Mrs. Fields) climbed from $3.8 billion in 1983 to over $5 billion in 1987.

In response, many wholesalers are investing in the promotional activities and new product development necessary to develop greater consumer loyalty, expand their market share, and increase their competitiveness with in-store and retail outlets.

"The rapid growth of in-store bakeries in recent years has forced wholesalers to re-examine the products they offer and their marketing methods," says Harwood.

Thus, she says, "wholesalers are beginning to take advantage of the promotional efforts used by in-store bakeries. Packaged baked foods that are displayed in the in-store bakery section, for instance, can reflect the same high-quality image of goods that are freshly baked. Items that have been successful at in-store bakeries—specialty items and single-serving portions—are now being marketed in prepackaged form by wholesalers."

Wholesalers are also stepping up the introduction of new items. In 1986, more than 550 new bakery products were brought onto the market.

But some observers disagree with the importance attributed to in-store bakeries. These observers argue that in-store bakeries charge premium prices that consumers will not likely pay on a regular basis. In addition, bake-shop purchases are often made on impulse.

For the future, the focus in the baking and milling industries will very likely sharpen to a greater struggle for profits, and the current emphasis on consolidation and concentration is expected to continue.

"Price competition may well accelerate," says Harwood. "And both the milling and baking industries will keep streamlining plant operations and building marketing strategies in order to boost profits." □

[Based on information supplied by economists Joy Harwood and Mack Leath of the Commodity Economics Division, Economic Research Service, and Walter Heid, former ERS economist.]

Exports of Wheat Flour Important to Millers

Wheat flour exports are providing welcome additional revenue to millers.

"Flour exports help millers maintain their level of grind, and allow them to achieve a level of profitability that would otherwise be difficult," says ERS economist Joy Harwood. "Flour exports averaged about 8 percent of total consumption between 1980 and 1987."

In 1987, the United States exported about 1.3 million metric tons of wheat flour, valued at nearly $203 million.

Government programs play a critical role here.

During the 1980's, in fact, the main government programs—P.L. 480 (food aid and long-term concessional credit), commercial credit sales by USDA's Commodity Credit Corporation, and the Export Enhancement Program—have been responsible for moving from 50 percent to over 90 percent of all flour exports.

"The U.S. government's Export Enhancement Program (EEP), initiated in 1985, appears particularly important in supporting the level of flour exports," says Harwood. "Without EEP pricing arrangements, U.S. shipments to targeted markets in the late 1980's would have likely remained at the 1984-85 level or lower, and shipments by the European Community (EC) would have been much larger. Even so, the EC remains by far the world's largest flour exporter."

Catfish Lead the Way As Aquaculture Booms

Aquaculture—the production of fish—has been growing by 20 percent per year in the United States since 1980.

In 1987, total aquaculture production was about 375,000 tons. Commercial fishing provided 1.8 million tons of edible fish, and imports accounted for 1.6 million tons. The recreational catch was a little less than 500,000 tons.

Catfish, salmon, trout, and crawfish made up 90 percent of U.S. aquaculture production in 1987, with catfish the leader by a wide margin. Oysters, mussels, clams, and shrimp are major aquaculture shellfish products.

The industry also produced 13,000 tons of baitfish and is expanding production of alligators, hybrid striped bass, carp, eel, redfish, northern pike, sturgeon, and tilapia—an African species gaining popularity in this country.

Total aquaculture production in 1987 was valued at more than $650 million. Catfish, trout, and baitfish were the three leading products, by value. Catfish was first at over $240 million, baitfish was valued at $70 million, and trout, $60 million.

Aquaculture is defined as the production of aquatic plants or animals in a controlled environment. It is growing because Americans are eating more seafood than ever before. In 1987, consumption of fish was 20.2 pounds per person, up from 17.1 pounds in 1980 and 15.9 pounds in 1970.

Economist Michael Dicks of USDA's Economic Research Service says that the increased consumption is due to changing consumer preferences and ethnic makeup of the population, increasing household incomes, and more aggressive marketing by processors and retailers.

Health concerns also affect consumer demand. Analysts have found that there is a strong perception that fish products have greater health benefits than red meat. But health concerns can also affect the market negatively. Last year's publicized coastal water pollution by raw sewage and medical wastes caused a strong decline in East Coast sales.

Catfish, salmon, trout and crawfish make up 90 percent of the U.S. aquaculture industry.

Consumers are attracted to value-added products. The catfish industry is developing partially or fully prepared products, promoting brand names, and hoping to establish product loyalty. The salmon and trout industries are doing the same on a smaller scale.

Prices affect demand. Wild ocean harvests increased significantly in 1987 for the first time since 1980, but analysts say they are not likely to continue. As U.S. income continues to grow, consumer demand for fish will increase and supplies will tighten. As a result, prices are likely to increase as they did in the spring of 1988. During that time, increasing feed prices in the aquaculture industry, plus consumer demand, drove up the prices of all fish. Analysts believe that further increases in prices could reduce demand for seafood.

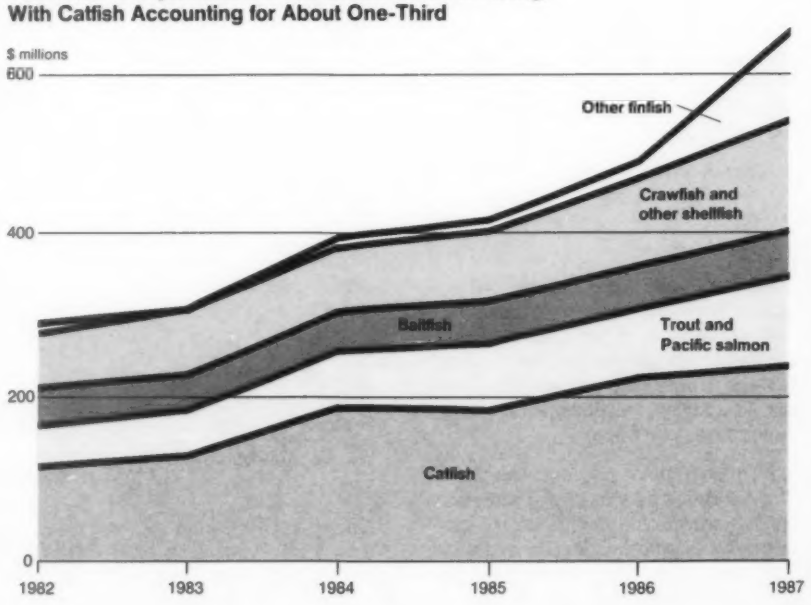
Wild ocean landings and imports can't keep up with the demand. Together they have provided a little less than three-fourths of U.S. seafood for the past 20 years. Analysts say that the commercial catch may be approaching maximum levels, and larger ocean harvests could cut down the future availability of most species.

Imports are growing, 50 percent in quantity and 100 percent in value since 1980, but still not fast enough to meet the growing consumer demand.

Recreational catches account for 11 percent of the seafood consumed in the United States, but these catches can yield only slightly more edible fish than the current amounts. The remaining 7 percent comes from aquaculture.

Worldwide, consumption of fish has increased 100,000 tons a year for the past 10 years. The Food and Agriculture Orga-

The Value of Aquaculture in the United States Is Rising, With Catfish Accounting for About One-Third



nization of the United Nations predicts that by the year 2000, demand for seafood will grow to 114 million tons, compared with 92 million today. Ocean harvests are expected to meet only 94 million tons of the projected demand.

Aquaculture and the Economy

Though a relatively new industry in the United States, aquaculture is a centuries-old practice in parts of Asia. Dicks explains that most initial ventures into aquaculture in the United States developed as an alternative to traditional agriculture in the late 1970's and early 1980's.

"Faced with a strong market for fishery products and weak markets for other commodities," says Dicks, "some farmers began to diversify into aquaculture. As feed became more efficient and more area was developed for ponds, raceways, and pens, farmers expanded their operations, and stocking rates increased. A marketing infrastructure developed, and aquaculture grew rapidly."

Fish farming is done in tanks, ponds, and raceways in inland water sources. Saltwater species can be grown in pens in ocean areas.

There are public or private aquaculture areas in every state, but the large commercial enterprises are concentrated in areas where management, capital, and marketing services are available.

For instance, catfish are bred in about 20 states that have relatively warm climates. But, according to Dicks, states such as North and South Carolina, Oklahoma, and Texas, with high quality water resources, don't generally have management and marketing services, or the low-cost capital necessary to develop an aquaculture industry.

Dicks says that in contrast, Mississippi, with sufficient management and marketing services, has more than three-fourths of the U.S. catfish sales with about one-fifth of the number of producers, and 64 percent of the acreage. But Mississippi does not have new sources of high quality water available to sustain industry expansion.

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Catfish are transferred from a seine to wire baskets.

Aquaculture provides a market for traditional commodities. It uses approximately 650,000 tons of domestic grain products for feed. Most diets for fish and shellfish are based on feeds developed for trout or catfish, and contain many of the same ingredients used for livestock feed.

The catfish, or warm water mix, contains 50-55 percent soybean meal, 25-35 percent corn, and 15-25 percent other nutrients including wheat, barley, oats, fishmeal, meat and bonemeal, and fats and oils. The trout, or cold water diet, contains a much higher percentage of fishmeal, 20-30 percent, and a wider variety of feeds such as whey products, wheat germ, cottonseed meal, and soybean meal and oil.

The catfish industry alone uses 300,000 tons of soybean meal or roughly 1.5 percent of total U.S. production. Analysts estimate that if aquaculture continues to expand at its current rate, the industry could consume almost 2 million tons of soybean meal and 2.15 million tons of domestic grain products by the year 2000.

But that's not all that this industry has contributed to the economy. Aquaculture has provided alternative employment and income opportunities to farmers. Farm acreage otherwise devoted to traditional commodities can be turned into production facilities for fish or shellfish.

Rural economies benefit from aquaculture because fish processing plants, which must be located near aquaculture production centers, are labor intensive. Studies indicate that 220 new jobs are created within the catfish industry for every additional 10 million pounds of fish produced. An additional 1,100 jobs are created in related urban and rural industries to provide inputs to aquaculture, transport and market products, and provide goods and services for new employees.

The United States has a large trade deficit in fish products. The value of imports in 1987 increased for the seventh straight year to a record $8.8 billion.

Imports of edible fish increased to a record $5.7 billion, almost $1 billion higher than the 1986 record. Japan, Thailand, and Taiwan sold us 32 percent of our total imports. The United States bought 26 percent from other North American countries and 20 percent from Europe. We spent the most on shrimp.

U.S. exports of all fish in 1987 were a record $1.7 billion, a fourth consecutive yearly increase but still much less than the value of imports.

Edible fish products accounted for more than 95 percent. Japan bought the most, 65 percent of U.S. exports. Canada was second, followed by the United Kingdom and France. Salmon was the major export.

Obstacles to Expansion

Aquaculture has the potential to continue to provide consistent, high-quality substitutes for imports and wild ocean harvests, but the industry needs to expand, and expansion will not come without growing pains.

According to Dicks, costs of feed and energy continue to be a limiting factor in aquaculture. Dicks says that highly variable production costs could place producers in a cost-price squeeze that would impede expansion.

Feed constitutes almost half of the finfish production costs. The cold water feed diets rely heavily upon fishmeal, which has more than doubled in value within the last year.

Warm water diets rely more on feed grains, which doubled in price last year. Higher prices for soybean meal (which comprises roughly 50 percent of the warm water finfish diet) led feed prices to jump up to 60 percent on forward orders. Dicks says that if the prices of feed grains and protein supplements remain high during the next few years, returns would be reduced and expansion stifled.

Another obstacle to expansion is the need for catch-up technology. Major new research efforts will be needed to assess nutritional needs by species and age, to develop therapeutics to treat diseases and eliminate parasites, and to develop genetically superior species.

David Harvey, another ERS economist, says that the lack of pharmaceuticals for fish is a "Catch 22." Drug firms are reluctant to spend the research dollars to develop the products needed until the demand justifies the investment. Meanwhile, demand from the producers is held up because expansion relies partly on improved pharmaceuticals.

Water quality is considered by most aquaculturalists to be the main problem facing growth of the industry. Analysts say that without a good source of high-quality water, free of contaminants, there can be no thriving aquaculture industry.

Aquaculture is vulnerable to groundwater contamination from the leaching of pesticides or fertilizers from adjoining lands into an aquifer, or from contamination of the ocean from dumping and pollution. Any of these problems could force authorities to ban harvesting from specific areas.

And finally, aquaculture operations face the problem of predators. Birds are the chief problem, but turtles, snakes, and other animals also interfere in production. Many of the predators, like herons, are protected by law, so little can be done about them.

Government's Role

Dicks says that institutional constraints have plagued the aquaculture industry from the very beginning. At the federal level, aquaculture falls under the jurisdiction of the Departments of Commerce, Interior, and Agriculture. Regulation comes from the Environmental Protection Agency, Army Corps of Engineers, and various state and local departments and agencies.

The many different federal, state, and local authorities involved with aquaculture complicate the task of developing or implementing an organized plan for industry expansion.

The industry, segmented by species, producers, and marketing firms, is presently not able to gain the attention from Congress that other commodity groups can. Dicks says that the industry would like to be able to look to one agency for its primary jurisdiction and regulation. Representatives of various segments of the industry have discussed forming a common political ac-

tion committee to try to obtain more public dollars for research and extension services.

Because of their lack of a long-term record of operation, many in the industry have difficulty getting loans. Start-up costs for aquaculture can be more expensive than many types of traditional farming. For example, construction costs for ponds are high, and the time it takes for fish to grow to maturity can be quite long compared with traditional crops.

Analysts say that the short-term outlook for aquaculture is influenced by the high fish prices and short supplies in 1988. These factors have led to expansion in acreage for many species. Acreage expansion, coupled with modest increases in feed efficiency and stocking rates, should lead to greater production in the next 2 to 3 years.

Prices should decline as the current markets become saturated. Dicks says that as growth slows, segments of the industry with aggressive processing or marketing firms will establish new markets with product differentiation and promotion.

The new markets should enable demand to continue to increase faster than supply, increasing prices and providing the industry with an incentive to expand. □

[Based on information provided by economists Michael Dicks and David Harvey of the Commodity Economics Division, Economic Research Service.]

Catfish are raised in ponds, primarily in warm-weather areas such as Mississippi.

Channel catfish are sorted for placement in feeding ponds.

Drought's Economic After-Effects Differ by Regions

Last year's drought brought some of the hottest, driest weather on record to the nation's midsection, and the economic after-effects are now being felt in many farming communities.

The consequences go beyond reduced yields on crop farms and higher feed prices for livestock producers. For the individual communities, the costs often include potential losses in jobs, income, and overall business activity in both the farm and nonfarm sectors.

Although federal drought legislation helped by targeting an estimated $3.9 billion in aid to farmers in the hardest-hit sections, some farming areas still face higher economic losses than others.

These regional differences are only partly explained by variations in the drought's severity, according to a team of economists in USDA's Economic Research Service.

"The ultimate impact of the drought on a local area is also tied to the importance of farming to the overall economy of the area, the diversity of the area's farm sector, the types of farming enterprises that predominate, and the distribution of federal drought-assistance payments," says Fred Hines, one of the economists.

For example, the two regions most affected by the drought are the spring wheat areas of the Northern Plains and the Northern Rocky Mountain states. Farming is the most important economic activity in these regions and is dominated by wheat and feed grains production. The drought cut wheat and feed grain yields by 70 to 75 percent in these areas, leading to reduced overall economic activity because of the importance of the crops.

In some other regions, extremely high temperatures and low precipitation levels had more limited consequences. The effects of the drought were cushioned by a more diverse farming sector that is smaller and not so critical to the area's overall economy. Such areas are typical of the more industrialized eastern Corn Belt region.

In some areas, the effects of the drought were cushioned by a more diverse farming sector that is smaller and not so critical to the area's overall economy.

To illustrate the varying impacts of the drought on the nation's farming communities, the economists chose five multicounty areas that suffered extreme drought conditions during the summer of 1988. These areas are located in northeast Montana, north central North Dakota, southwest Wisconsin, east central Illinois, and northwest Ohio.

To measure the economic effects of the drought, the ERS analysts looked at direct income losses in the farm sector, the overall economic impacts on the regional economy, and the compensating effects of drought assistance.

In the analysis, crop production losses are the estimated dollar value of the 1988 deviations from normal yield, based on preliminary (August 1988) yield estimates. Losses in the livestock sector are estimates of decreased income resulting from drought-related increases in feed grain and forage prices.

The economists also calculated the indirect impacts of the drought on farm-related and nonfarm sectors. This analysis involved a study of economic links within the entire regional economy, links between farm and nonfarm sectors, and links to economic activities outside each region.

"With lower incomes, farm households obviously have less money to spend," says Hines. "Some spending on basic items has been postponed, and nonfarm businesses, particularly in the retail and service sectors, have suffered substantial declines."

Following are brief sketches of the drought's effects on the five areas and how they are likely to fare because of it.

Northeast Montana

Farmers in the eight-county area of northeast Montana are vital contributors to the economic life of this region.

About 23 percent of the jobs are in the farm production sector, with another 5 percent of all jobs in agribusiness industries such as farm inputs and farm processing and marketing.

The major farm enterprises in the area are the large-scale wheat farms and cattle ranches that sprawl across the landscape. More than 80 percent of all farm sales in northeast Montana, in fact, are from wheat and cattle operations.

The average farm covers more than 3,500 acres, compared with the U.S. average of 440 acres. But the average farm sales ($60,452) are only slightly above the U.S. average, suggesting the low capital and labor intensity of farming and ranching operations in this area.

The decade began here with a boost to the local economy from a rapid expansion in the energy sector. Beginning in 1983, however, problems in the overall U.S. energy sector caused some loss of jobs and population.

The area was still struggling in 1988, when the drought slashed wheat and barley yields by 70 to 75 percent.

In dollar terms, the direct farm loss from the drought is estimated at $152.5 million, most of it in the food grains (mainly wheat) sector. An estimated federal drought assistance payment of $68 million reduces this loss to around $85 million.

The impact on the overall economy could be substantial as well. The economists estimated the potential drop in total business activity at about 13 percent, after federal drought assistance.

North Central North Dakota

Of the areas studied, this five-county area in North Dakota is the most dependent on farm production activities for its economic base.

Almost a third (32.1 percent) of all jobs in this area are in the farm production sec-

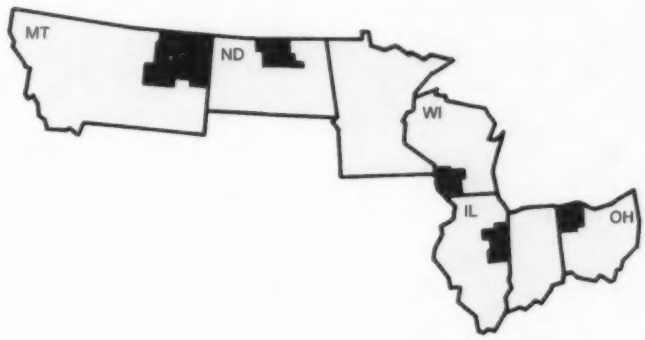
tor, with another 3 percent in agribusiness employment. Farms in this area produce mainly wheat and barley, which accounted for more than three-fourths of all farm sales in 1982. Sales in the livestock sector are primarily beef cattle, but include some dairy and swine. Farm sales were typically lower than the national average, with most sales coming from medium-sized farms.

As was the case with northeast Montana, the early 1980's brought modest energy-related growth to this area. But by the mid-1980's, problems in the energy sector as well as the farm sector caused a reversal in the growth.

The 1988 drought reduced wheat and feed grain yields in the area by 70 percent, hitting the area's dominant farm enterprises hard. The estimated farm loss for this area is $114.6 million, with federal drought assistance payments offsetting about $35 million of that loss. Without federal drought assistance, the drop in total business activity could have reached more than 20 percent, says Hines.

"But as much as half of the direct federal aid to farmers will likely bypass the local business centers," he says. "In North Dakota, for instance, a substantial portion of the local disaster payments may be spent in large urban centers outside the area, since the farm-based, sparsely-developed communities cannot provide as full an array of consumer goods and services."

All Five Study Areas Were Hit by 'Extreme' Drought Last Summer. . .



. . .But Estimated Economic Losses Are Different for Each Area

	Northeast Montana	North Central North Dakota	Southwest Wisconsin	East Central Illinois	Northwest Ohio
Population/employment data					
Population (1986)	58,000	43,000	195,000	463,000	977,000
Employment (1985)	22,000	15,000	75,000	191,000	421,000
Share of total employment in:					
Farm production	22.7%	32.1%	26.0%	6.9%	4.2%
Agribusiness	4.9%	3.0%	4.9%	5.1%	2.9%
Other farm related[2]	10.3%	6.1%	10.1%	12.0%	11.8%
Farm data					
Avg. farm size (acres)[1]	3,566	1,153	289	377	252
Avg. farm sales per farm[1]	$60,452	$53,412	$61,138	$94,835	$50,178
Share of sales:					
from crops[1]	68.4%	79.5%	13.8%	85.8%	67.6%
from livestock[1]	31.6%	20.5%	86.2%	14.2%	32.4%
Potential losses in farming					
Direct losses ($ mil.)[3]					
Crop sector	-145.3	-110.3	-45.4	-311.9	-144.3
Livestock sector	-7.2	-4.3	-88.8	-14.1	-20.5
Total	-152.5	-114.6	-134.2	-326.0	-164.8
Federal drought payment ($ mil.)	68.0	35.2	29.4	108.0	31.2
Net estimated loss ($ mil.)	-84.5	-79.4	-104.7	-218.0	-133.6
Potential drop in business activity due to drought[4]	13.1%	21.5%	3.0%	3.8%	0.7%

[1]Data from 1982 Census of Agriculture. [2]Includes food and fiber wholesaling and retailing, plus indirect agribusiness. [3]Based on August 1988 yield loss estimates. [4]Drop as a percent of total gross output. The potential drop in business activity accounts for both direct and indirect effects of the drought on the local economy but does not take into account any federal drought assistance. [5]Percentages do not add to 100% because of disclosure deletions for some data items.

Southwest Wisconsin

In the seven-county area of southwest Wisconsin, the agricultural sector is largely based on medium-sized dairy operations. A fourth of all employment here is in farm production activities, with another 5 percent employed in the closely linked agribusiness industries. More than half of all farm sales are dairy products.

Sales of cattle and calves comprise almost one-fifth (17.8 percent) of all farm sales, probably stemming from the sale of cull and excess cattle from dairy operations. For this area, the 1988 drought caused feed shortages that raised feed costs for dairy operations.

The direct loss to farmers is calculated at $134.2 million, largely because of higher feed costs. These losses will be partly offset by the estimated $29.4 million in federal drought assistance.

Hines adds that "drought assistance payment calculations for southwest Wisconsin may be underestimated since dairy operators who normally don't produce all their feed requirements were eligible to purchase CCC-owned grain at 75 percent of the loan rate, and such potential assistance to livestock enterprises was not estimated."

(continued on next page)

Since the nonfarm economy of southwest Wisconsin is large and more diversified, the effect on area businesses will be much more modest here. Purchased or imported feed had to be substituted for locally produced feed. The diversified nonfarm economy was less affected by local production conditions and more by national conditions. About a 3-percent drop in business activity is expected.

East Central Illinois

Located in the heart of the Corn Belt, this seven-county area represents one of the most productive farming areas of the United States. Its corn yields are normally 40 percent above the U.S. average.

While the farm sector is important to the area, the economy is not highly dependent on farming. Most local jobs are in industry or government, with farm production activities accounting for about 7 percent of employment. Agribusiness adds another 5 percent of the jobs.

Despite the much larger population base than in the other selected study areas, this area has lost population since 1980, with six of the seven counties having some population loss during the 1980's. "Such losses reflect recent adjustments in the industrial base of the area and are somewhat typical of many areas throughout the industrialized midwestern states," says Hines.

The farm sector here is dominated by medium to large corn-soybean farms. These crops generate over 80 percent of farm sales in the area. The smaller livestock sector produces mainly hogs and accounts for only about 14 percent of farm sales.

The corn yield for 1988 was estimated at 70 bushels per acre, compared with a normal yield of more than 140 bushels. The soybean yield was estimated to be down 25 percent.

This area has the largest direct farm loss of the areas studied, $326 million, but it also received the largest federal payment of the five areas, an estimated $108 million. A drop-off in business activity in the range of 3-4 percent is expected because of the drought.

Northwest Ohio

The 11-county area of northwest Ohio is dotted by farms, but dominated by nonfarm economic activities.

The farm production sector accounts for only 4 percent of total employment, and the agribusiness sector contributes another 3 percent.

Corn and soybeans make up more than half of all farm sales, while the sales of hogs, cattle, and calves account for another 20 percent of sales.

Farms in the area are smaller than the U.S. average, both in sales and in acres. Farms with sales of less than $40,000 were more numerous here than in other selected study areas. This indicates the importance of part-time farming in the area and the strong nonfarm influence on the activities of the farm sector.

Corn and soybean yield losses in northwest Ohio were estimated to be 40 percent and 25 percent, respectively. Total direct losses of some $164.8 million were experienced by farmers here. Drought payments of around $31 million reduced the net loss to around $133.6 million.

The drought's effect on business activity is expected to be very modest—less than 1 percent.

The drought of 1988 brought difficult times for many farmers and farm-based regions of the country. The economists note, however, that predictions about what's ahead in 1989 are obviously risky.

The effects of the drought include reduced stocks of grains and soybeans, higher commodity prices, and lower acreage set-aside requirements in 1989. For U.S. agriculture in general, the economists say, 1989 looks like a promising year. But, as always, much depends on the weather. For some areas of the country, especially the Northern Plains, moisture levels are still low, underscoring the uncertainty of farming. □

[Based on information provided by economists Fred Hines, Mindy Petrulis, Judith Sommer, David Henderson, and Jackie Bhola, all of the Agriculture and Rural Economy Division, and Tom Herbert, formerly of the Resources and Technology Division, Economic Research Service.]

Crop-Based Foods Show Biggest Gains

USDA's index of per capita food consumption has risen in 13 of the last 22 years. This price-weighted index measures changes in the quantities of foods used per person in the United States, but it also reflects some shifts between lower and higher priced foods.

In 1987, the index set another record, for a total gain of almost 11 percent since 1966.

Over the 1966-87 period, per capita consumption of crop-based foods climbed nearly 18 percent, compared with a relatively weak 5-percent overall increase for animal-based foods.

Among the significant gainers:
- Poultry—77.8 pounds per capita in 1987, up from 43.4 pounds in 1966.
- Lowfat milk—113.6 pounds, up from 33.5.
- Cheese—24.0 pounds, up from 9.7.
- Pasta products—17.1 pounds, up from 5.8.
- Salad and cooking oils—25.2 pounds, up from 12.7.
- Fresh fruit—98.6 pounds, up from 79.1.
- Frozen potatoes—23.2 pounds, up from 12.2.

Among the losers:
- Red meats—144.0 pounds per capita in 1987, down from 150.8 pounds in 1966.
- Eggs—31.6 pounds, down from 39.8.
- Whole milk—109.9 pounds, down from 250.5.
- Canned peaches—3.4 pounds, down from 6.4.

This statistical report covers per capita U.S. consumption of major food commodities. Most tables show annual data from 1966 to 1987. Related tables cover food supply and use, consumer price indexes, food expenditures, and the nutrient content of the U.S. food supply.

Food Consumption, Prices, and Expenditures, 1966-87 *by Judith Jones Putnam. Published January 1989; 111 pages of data; $8.00 ($10 to non-U.S. addresses).*

Many Laws Affect Farm Employers

Most federal laws governing wages and working conditions do not affect a farmer who hires a few part-time workers each year to help with the planting or harvest.

However, as more farmers find they need a permanent labor force to help run a growing operation, more federal laws and regulations begin to apply. To meet the legal requirements and avoid potential penalties, the agricultural employer needs to be familiar with these laws.

The Fair Labor Standards Act sets the federal minimum wage, the maximum hours of employment allowed without overtime pay, and child labor standards. Several exemptions are provided for agriculture.

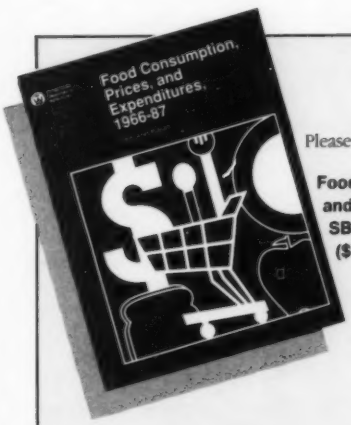
The Occupational Safety and Health Act establishes requirements for temporary labor camps. It also sets various sanitation and cleanliness standards, requiring, for example, the availability of drinking water and toilet facilities on farm fieldwork sites. Agricultural employers with 10 or fewer workers are partially exempt from many of the provisions.

The Migrant and Seasonal Agricultural Worker Protection Act is the only major labor law dealing specifically with agricultural employment. It includes provisions that apply to labor contractors, workers, and employers.

Other applicable laws include the Immigration Reform and Control Act of 1986, state workers' compensation laws, and various federal tax laws that require the withholding of income, Social Security, and unemployment taxes by the employer.

This report summarizes these laws and regulations, discussing how they apply to farm employers, the exemptions for agriculture, and the penalties for violations.

A Summary of Federal Laws and Regulations Affecting Agricultural Employers *by Jack Runyan. Published January 1989; 18 pages; $5.50 ($7 to non-U.S. addresses).*



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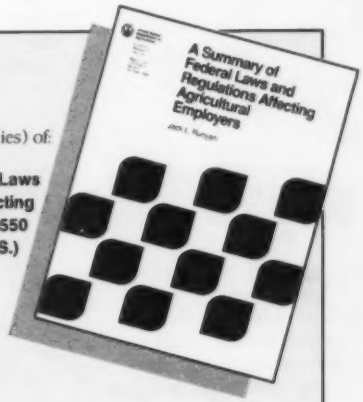

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Ethanol Producers Strive To Cut Costs

Fuel ethanol producers are keeping an eye on the 1990's as they speed up their efforts to create a less costly product.

Ethanol is blended with gasoline (currently nine parts gasoline to one part ethanol) as an automotive fuel. Most U.S. ethanol is produced from corn.

The first critical date for the industry comes next year, when the current farm bill is set to expire. New or amended legislation could mean modifications in price support programs, which in turn could bring about changes in corn supplies and prices. That would affect the costs of producing ethanol.

The next date of concern is January 1, 1993, when the federal excise tax exemption for ethanol production will end, unless extended by Congress. Ethanol producers are hoping to convince policymakers that fuel ethanol should be an ongoing part of the nation's energy strategy.

"The energy crisis caused by the 1973 petroleum embargo drove home the need to reduce the nation's dependence on imported oil and develop less expensive and more reliable domestic fuel sources," says economist Sally Kane of USDA's Economic Research Service.

Through the 1970's, public support for alcohol fuels ran high. One objective of the 1980 Energy Security Act was to boost alcohol fuel production to 10 percent of domestic gasoline consumption by 1990.

In the 1980's, as oil prices have weakened, so has the sense of urgency over alternative fuels.

At the same time, however, ethanol production and use have grown steadily and substantially, supported by a mix of federal and state incentives. Dramatic industry growth has been combined with rapidly changing economic conditions that affect the profitability of companies producing ethanol.

The industry suffered losses in 1986 when crude oil prices dropped to $10 per barrel and again in 1988 when corn prices rose above $3 per bushel because of the drought. In addition, some plants have suffered from poor design and management, according to Kane.

"There is an opportunity for reducing the costs and improving the efficiency of fuel ethanol production because the technology used in large-scale production of liquid alcohol from grain is relatively new," she says. "Today, a state-of-the-art plant could produce ethanol with almost 20 percent lower operating costs than the average existing plant."

One of the new technologies with potential for lowering operating costs is the use of the bacteria *Zymomonous mobilis* as a replacement for yeast. In the laboratory, these bacteria can tolerate higher temperatures than yeast, and this could lead to more rapid fermentation rates in commercial production.

Given further advances in processing technology, ethanol might eventually be produced from cheaper feedstocks, such as woody plants and a wide range of organic wastes, says Kane. With current technology, production from these feedstocks is not cost competitive relative to grains, especially if grain prices drop back to pre-drought levels.

Matched against gasoline prices, ethanol produced using average existing technology (with $2-a-bushel corn and the existing federal subsidy) is competitive if crude oil trades at $22-$24 per barrel or higher. If state-of-the-art technology is used, ethanol becomes competitive when crude oil is at $20 per barrel.

"Further technological improvements expected within 3 to 5 years could make ethanol competitive when crude oil is $18 per barrel," Kane says, noting that this analysis also assumes $2-a-bushel corn and the existing federal subsidy.

The federal subsidy is a key variable. Recent USDA estimates indicate that, with state-of-the-art technology but *without the subsidy*, ethanol would not be competitive until crude oil prices reached at least $40 per barrel. (For comparison, crude oil prices were in the $13-$15 range at the end of 1988 and were rising slightly in early 1989.)

Production costs and energy security, however, are not the only issues in the ethanol debate. Producers also argue for ethanol on the basis of other national goals, including environmental and agricultural concerns.

Ethanol use, for example, can cut carbon monoxide emitted by motor vehicles. Colorado is requiring the use of oxygenated fuels (including gasoline-ethanol blends) during the winter season to reduce levels of carbon monoxide. Other states, including Arizona and New Mexico, have recently passed legislation creating oxygenated fuels programs to lower carbon monoxide levels.

The use of blended gasoline may initially decrease carbon monoxide levels 3 to 10 percent at sea level and possibly as much as 20 percent at high altitudes. After that, air quality improvements could slow, Kane says, with continued growth in population and the number of vehicles. In addition, fuel ethanol may have negative effects on other air quality components, under certain conditions.

"Adding ethanol to gasoline increases fuel volatility and thus increases the amount of evaporative hydrocarbon emissions," she notes. "Ozone is not directly emitted by vehicles but forms in the air by the reaction of volatile, organic compounds in the presence of sunlight. Without compensating changes in fuel formulation, the widespread adoption of alcohol fuels could increase the evaporation problem and local ozone levels."

Unlike the protective ozone layer in the upper atmosphere, too much ozone in the air we breathe can contribute to smog, aggravate respiratory conditions, and potentially reduce crop yields. Ozone pollution is already a problem in some parts of the country.

Under current law, increased ethanol production would also reduce the tax revenues going into the Highway Trust Fund. The fund helps finance new highways and road improvements. Because gasoline-ethanol blends are now exempt from 6 cents of the 9-cent-per-gallon federal excise tax on motor fuels, highway fund revenues would decline by 60 cents for every gallon of ethanol used. (One gallon of ethanol produces 10 gallons of blend, replacing 10 gallons of gasoline taxed at the higher rate).

For agriculture, "ethanol takes on added importance as an alternative use for corn in times of low export demand," says Kane. "Expanded demand for grain by the fuel ethanol industry can sometimes partially substitute for more traditional agricultural programs which have relied on price supports, supply control, and grain reserves in reducing excess domestic supplies."

Beyond simply slicing into excess supplies when they exist, increased ethanol production could strengthen corn prices and raise net farm income modestly.

"The total effect of ethanol production on farm income is projected by combining the effects on crops and livestock," says

Kane. "In general, losses to livestock producers (from higher corn prices) are offset by gains to some crop producers, particularly corn and sorghum producers."

If ethanol production grew moderately to about 3 billion gallons per year within the next decade (roughly three times the current production level), then total gains to farm income are estimated at less than $1 billion. This is equivalent to about 2½ percent of 1988's net farm income.

Agricultural Exports Create 903,000 Jobs

Nearly a million jobs are generated by U.S. agricultural exports. In 1987, the total was an estimated 903,000.

Farm exports that year were valued at $28.6 billion. Production from more than a third of harvested U.S. cropland is exported.

Farmers and farm workers accounted for about 381,000 of the export-related jobs, according to economist William Edmondson of USDA's Economic Research Service. The other 522,000 jobs were outside the farm sector, but all were directly or indirectly related to the processing and distribution of farm exports.

The total business activity created by farm exports far exceeds the actual sales. In fact, Edmondson's calculations suggest that each dollar received from agricultural exports in 1987 stimulated another $1.65 of output in the U.S. economy. For example, farmers buy machinery and chemicals to produce exported crops. Cattle producers buy feed to produce exported animal products. And farm products need to be processed, packaged, and transported to their destinations.

The result is that the nearly $29 billion in agricultural exports generated another $47.2 billion in supporting activities. This additional economic activity included $7.2 billion in the farm sector, $3.7 billion in the food processing sector, $15.2 billion in other manufacturing sectors, $5.8 billion in trade and transportation, and $15.3 billion in other services.

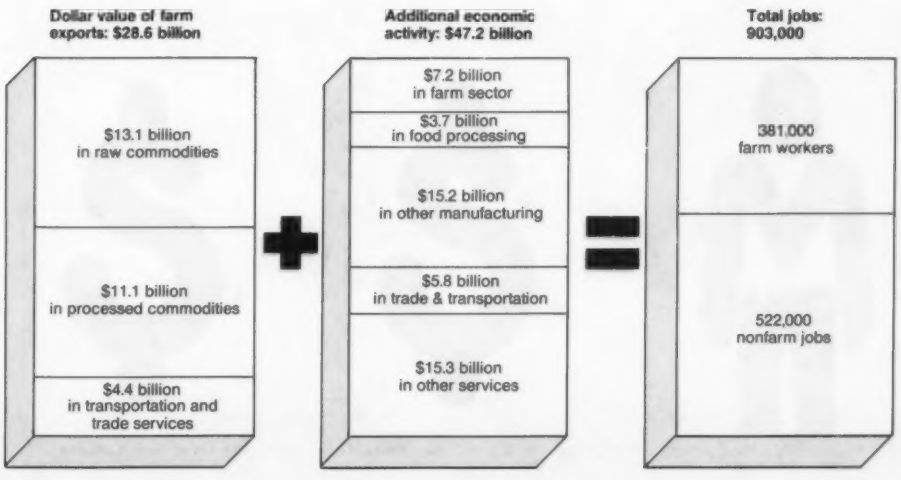
Thus, about 85 percent of the additional economic activity from farm exports was in nonfarm sectors.

The $28.6 billion worth of farm exports included $13.1 billion in raw products, $11.1 billion in processed commodities, and $4.4 billion in transportation and trade services.

The $13.3 billion worth of direct bulk exports generated $20.5 billion of additional business activity.

Early in the 1980's, when export sales were considerably larger, even more jobs and economic activity were generated from farm exports. In the peak year of 1981, when $43.3 billion worth of exports were sold, export-related employment was estimated at 1.2 million, about a third higher than the 1987 figure. U.S. farm exports fell by about a third between 1981 and 1986.

Agricultural Exports Generate Nearly a Million Jobs in the United States


Dollar value of farm exports: $28.6 billion
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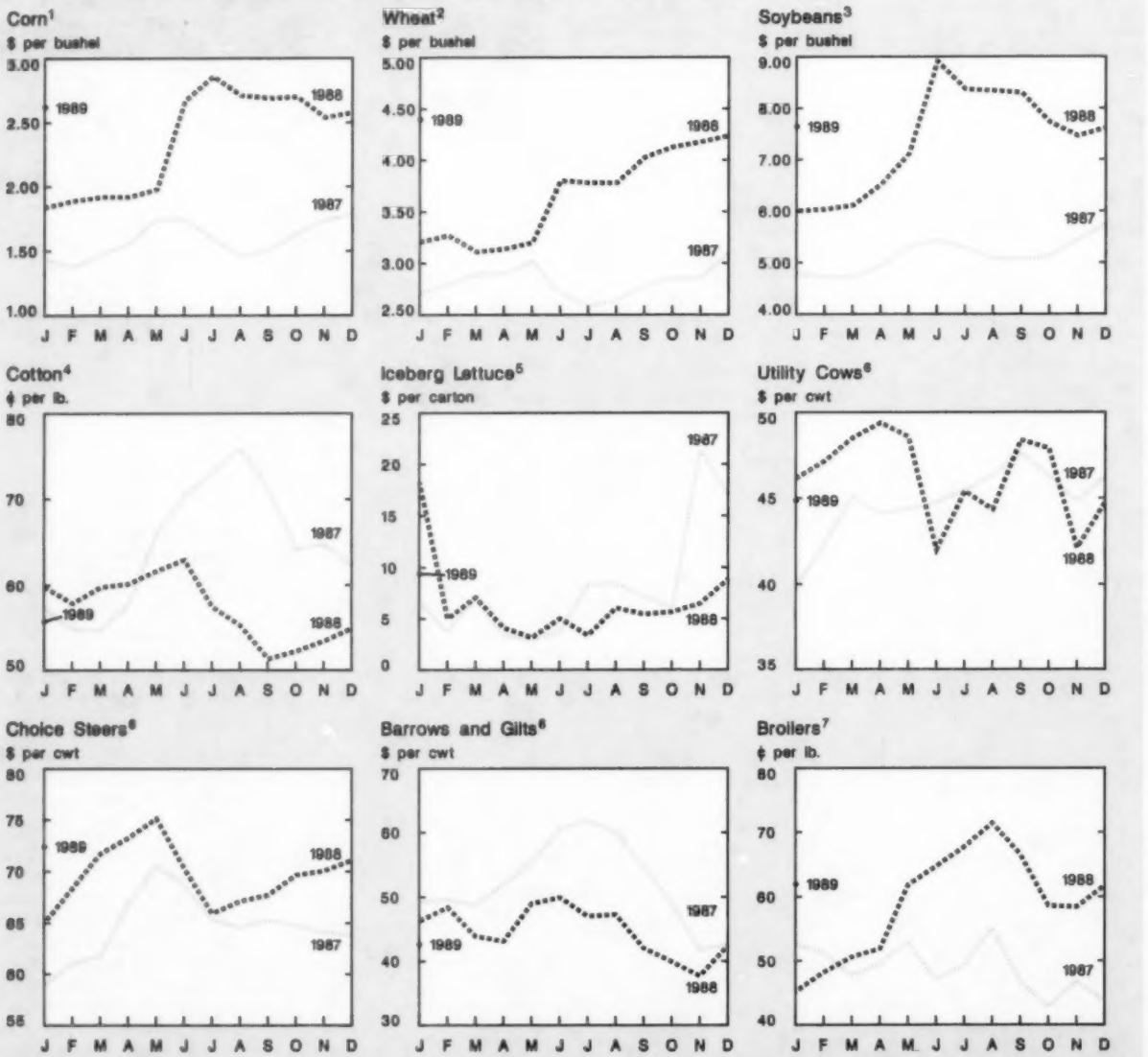
$11.1 billion in processed commodities
$4.4 billion in transportation and trade services
Additional economic activity: $47.2 billion
$7.2 billion in farm sector
$3.7 billion in food processing
$15.2 billion in other manufacturing
$5.8 billion in trade & transportation
$15.3 billion in other services
Total jobs: 903,000
381,000 farm workers
522,000 nonfarm jobs

Monthly Price Monitor

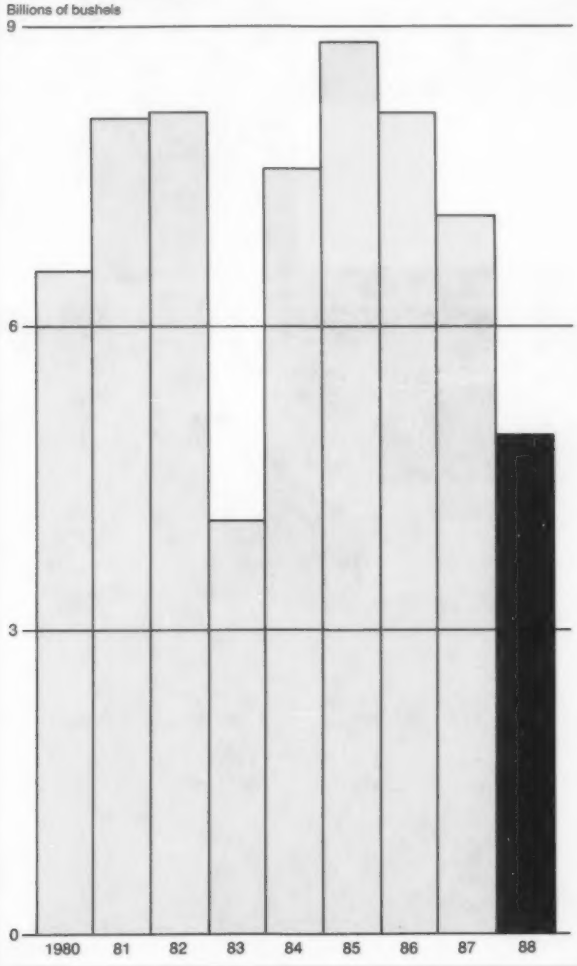
USDA's January 1989 index of farm prices increased 1.4% from December and was 12 percent above its year-earlier level. Corn started the year at $2.62 per bushel, 78¢ above its January 1988 price. Wheat hit $4.40, its highest since Nov. 1981 and $1.19 above its year-earlier level. Soybeans were $7.65, up from $6.01, while cotton was off 4¢ per pound to 55.7¢. Lettuce prices were down nearly 50% from Jan. 1988. Among meat animals, utility cows began the year at $44.88 per cwt, $1.29 below their year-ago level. Choice steers, at $72.40, were up more than $7. On a weaker note, barrows and gilts sold for $42.66, compared with $46.28 a year earlier. Broilers went for 62¢ a pound, well above Jan. 1988's 45¢. All prices shown are monthly averages.



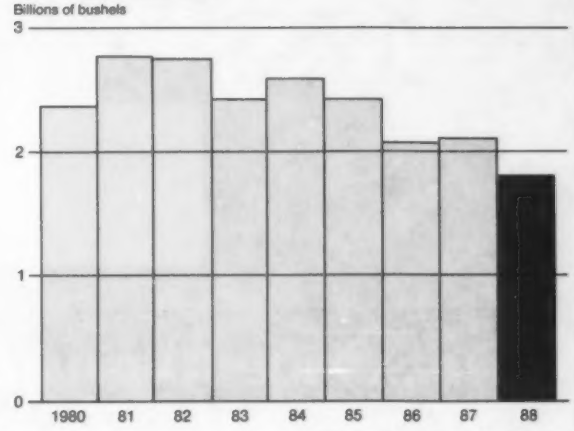
[1]No. 2 yellow, Central Illinois. [2]No. 1 HRW, Kansas City. [3]No. 1 yellow, Central Illinois. [4]SLM 1-1/16", spot market price. [5]Standard carton 24's, California-Arizona. [6]Omaha. [7]Wholesale, New York.

Sizing Up the 1988 Harvest

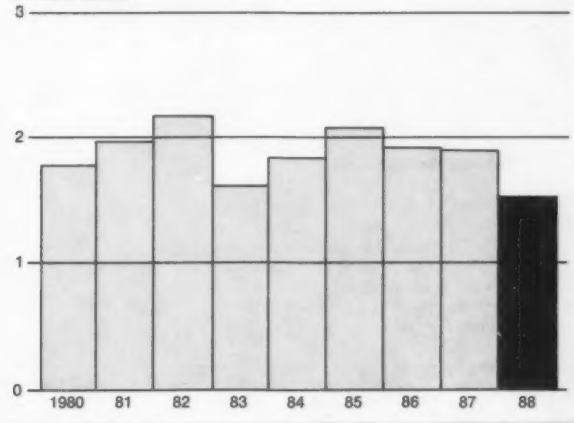
U.S. Corn Production



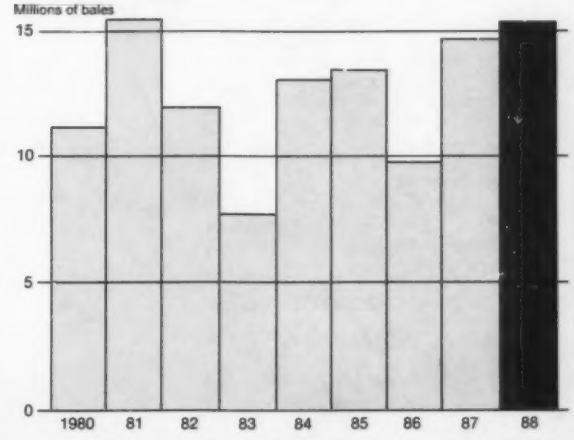
U.S. Wheat Production



U.S. Soybean Production



U.S. Cotton Production



Acreage, Yield, and Production Statistics

	1980	81	82	83	84	85	86	87	88
Corn									
Acres planted (mil.)	84.0	84.1	81.9	60.2	80.5	83.4	76.7	65.7	67.6
Acres harvested (mil.)	73.0	74.5	72.7	51.5	71.9	75.2	69.2	59.2	58.2
Avg. yield (bu./acre)[1]	91.0	108.9	113.2	81.1	106.7	118.0	119.3	119.4	84.6
Production (mil. bu.)	6,639	8,119	8,235	4,175	7,674	8,877	8,250	7,072	4,921
All Wheat									
Acres planted (mil.)	80.8	88.3	86.2	76.4	79.2	75.6	72.1	65.8	65.5
Acres harvested (mil.)	71.1	80.6	77.9	61.4	66.9	64.7	60.7	56.0	53.2
Avg. yield (bu./acre)[1]	33.5	34.5	35.5	39.4	38.8	37.5	34.4	37.7	34.1
Production (mil. bu.)	2,381	2,785	2,765	2,420	2,595	2,425	2,092	2,107	1,811
Soybeans									
Acres planted (mil.)	70.0	67.8	70.9	63.8	67.8	63.1	60.4	58.0	58.9
Acres harvested (mil.)	67.8	66.2	69.4	62.5	66.1	61.6	58.3	57.0	57.4
Avg. yield (bu./acre)[1]	26.5	30.1	31.5	26.2	28.1	34.1	33.3	33.7	26.8
Production (mil. bu.)	1,798	1,989	2,190	1,636	1,861	2,099	1,940	1,923	1,539
Cotton									
Acres planted (mil.)	14.5	14.3	11.3	7.9	11.1	10.7	10.0	10.4	12.5
Acres harvested (mil.)	13.2	13.8	9.7	7.3	10.4	10.2	8.5	10.0	11.9
Avg. yield (lbs./acre)[1]	404	542	590	508	600	630	552	706	623
Production (mil. bales)	11.12	15.65	11.96	7.77	12.98	13.43	9.73	14.76	15.45

[1]Average U.S. yield per harvested acre.
Source: *Crop Production, 1988 Summary*, January 1989, National Agricultural Statistics Service, USDA.

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